TO
HIS GRACE
The Duke of Marlborough
THIS
ASTRONOMICAL ROTULA
IS
(BY PERMISSION)
MOST HUMBLY DEDICATED,
BY
HIS GRACE's
MOST OBEDIENT
HUMBLE SERVANT,
George Margetts.

No 12. Ludgate Street
London

DESCRIPTION

OF A NEW

Aſtronomical Rotula,

For ſhewing the RISING and SETTING of the SUN, MOON, and STARS, with the PLACE of the MOON'S NODE, and the MEAN TIME of NEW and FULL MOONS, and ECLIPSES for 6000 Years before or after any Year of the 18th Century; made on the ſame Conſtruction, and ſerving to illuſtrate and explain his new invented aſtronomical Clocks and Watches.

ON the four Corners of the large Plate are Tables for ſhewing the Mean Time of the firſt New Moon in *January*, to the neareſt Hour, from 1763 to 1910, according to the New Stile.

Within theſe, on the Outſide of the Plate, is a ſpiral Line, with the Years from 1800 to 1910, for ſhewing the Place of the aſcending Node. Each Year is ſubdivided into 12 Parts, for the Months.

The next within this Spiral is a Circle divided into 365 equal Parts, for ſhewing the Day of the Month, with the Initials of the Month fixt round it.

Within this Circle is another Spiral, with the Years from 1763 to 1800, each Year divided into 12 equal Parts, &c.

Within this Spiral is another Circle, divided into 360 Degrees, with the Initials of the twelve Signs fixt to it, and numbered 10, 20, 30, 10, 20, &c.

Within this Circle is another, divided unequally, for ſhewing the Declination of the Sun and Moon; which is ſhewn by their reſpective Indexes.

The Inſide of this Plate has the Conſtellations, with the Stars of the firſt, ſecond, and third Magnitude laid down on it, according to their Right Aſcenſions and Declinations, expreſſed by *Bayer's* Characters, for the more eaſy finding them.

The Ecliptic is laid down by an eccentric Circle, divided into 360 Degrees, with the Signs, &c. for ſhewing the Place of the Sun and Moon; and the Circles of Latitude and Longitude are laid down to every tenth Degree by dotted Circles.

The Equator and Tropics, with Circles of Declination to every tenth Degree, are laid down by concentric Circles. That in the Middle is the Equator, with its Name upon it, and is divided into 360 Degrees, for ſhewing the Right Aſcenſion of the Sun, Moon, and Stars, both in Degrees and Time, having the Hour-Figures annexed to it. The inner black Circle is the Tropic of Capricorn, and the outer the Tropic of Cancer.

The next Plate above this is the Node Plate, with an Index at the Aſcending Node, for ſetting the Node and ſhewing its Place. The Node Circle, is ſupported by this Index and three other Bars from the Node Plate. This Circle has the Moon's Latitude laid down on it, and

and likewise the Distance of the Sun and Moon from the Ascending Node, in Signs and Degrees, which are always shewn by their respective Indexes. At the Distance of seventeen Degrees from each Node is a small Sun engraved; and, when the Sun is within that Distance from either Node at the Time of New Moon, the Sun will be eclipsed. At the Distance of 12 Degrees from each Node is a small Moon, for shewing the Limits of the lunar Eclipses, which are represented by two large black Spots on the Node Plate, beneath the other Plates.

The next above this is the Sun's Plate, having an Index with a Sun engraved on it, and the Fiducial * Edge divided into the Degrees of Declination. The Outside of this Plate has the Hours engraved on it, with the Words, *Morning*, *Afternoon*, and *Night*, and is always used as the Hour Circle; which Words always express the Part of the Day required. Within the Hours is a Circle of all the New and Full Moons in a Year: the black ones represent the New, and the others the Full, Moons. Within this Circle, under the other Plate, is engraved the Moon's Age.

The next, or fourth, is the Moon's Plate, having an Index with a Moon and the Degrees of Declination engraved on it. This Plate is divided round the Edge into 24 Hours, for shewing how long the Moon will be before it rises, souths, or sets. Within these Hours is a shaded Ellipsis, to represent the Tides, with the Words,

* The Edge that lies in a strait Line from the Center of the Plate is called the Fiducial Edge, and is considered as the Index itself in setting it to any Day or Degree.

Words, *High-Water*, *Tide-Fall*, *Low-Water*, &c. for ſhewing the State of the Tides, at all Places, on the uppermoſt Plate. Oppoſite the Moon, in this Plate, is a Hole through which the Moon's Age appears, and likewiſe the Eclipſes of the Sun and Moon.

The Top or fifth Plate is the Tide Plate, with the Points of the Compaſs, having the Names of 32 Sea-Ports ſet round it to thoſe Points of the Compaſs which the Moon is on when it is High-Water; which is ſhewn by the ſhaded Ellipſis on the Moon's Plate. This Plate ſupports a large Oval. The Outſide Edge is the Horizon, with the Degrees of Amplitude on it, for ſhewing the Amplitude and Azimuth of the Sun, Moon, or Stars, at Riſing and Setting. The inner Edge of the Oval is the Boundary of Twilight. The Meridian is divided into Degrees, for ſhewing the Meridian Altitude of the Sun, Moon, and Stars, and always acts as the Index to the Hour Circle.

PROBLEM I.

To find the Sun's Place in the Ecliptic, Right Aſcenſion, and Declination, on any Day in the Year.

Bring the Fiducial Edge of the Sun's Index to the given Day, and it will ſhew its Place in the Ecliptic, the Ecliptic Circle, its Right Aſcenſion in the Equator both in Degrees and in Time, and its Declination in the Circle of Declination, (within the Circle of Months;) the Declination will likewiſe be ſhewn on the Sun's Index by the Ecliptic, which always croſſes the Degree of Declination. Note, the Degree of the Sun's Index that the Ecliptic croſſes is always conſidered as the Sun's Center

Center in all Problems, which is the ſame as though the Sun were made to ſlide up and down the Bar.

EXAMPLE.

Required the Sun's Place in the Ecliptic, Declination, and Right Aſcenſion, on the Noon of the 5th of March. — Bring the Sun's Index to the 5th of *March*, and it will ſhew its Place to be about 13 Degrees in Piſces; its Right Aſcenſion about 344 Degrees, or 22 Hours 56 Minutes; and its Declination about 7 Degrees South.

PROBLEM II.

To find the Riſing and Setting of the Sun, with its Meridian Altitude, Amplitude, and the Duration of Twilight, on any Day of the Year.

Set the Sun to the Day of the Month, as in the laſt Example; then turn the Horizon till the Eaſtern Edge of the Twilight Circle comes to the Degree of Declination; the Sun's Index that the Ecliptic croſſes, and the Time of Beginning of Twilight, will be ſhown on the Hour Circle. Then turn the Horizon till the outer Edge comes to the ſame Degree on the Sun's Index, and it will ſhew its Amplitude on the Horizon, and the Time of the Sun's Riſing will be ſhewn by the Hour Index. Then bring the Meridian to the Sun's Index, and the ſame Degree will ſhew its Altitude on the Meridian; the Setting, Amplitude, and Evening Twilight, are ſhewn in the ſame Manner by the Weſtern Edge of the Horizon, and the Times are ſhewn by the Hour Index.

EXAMPLE 1ſt.

Required the Time of the Sun's Riſing and Setting, Amplitude, Beginning and Ending of Twilight, and meridian Altitude,

tude, on the 5th of March.—Having set the Sun to the 5th of *March*, bring the Eastern Edge of the Twilight Circle to 7 Degrees; the Sun's Delination on his Index, and the Time of the Beginning of Twilight, will be about 40 Minutes past 4, and the Sun rises about Half past 6, o'-Clock; the Amplitude will be about 9 Degrees from the East toward the South. Then bring the Meridian to the Sun's Index, and his Declination, 7 Degrees, will cut $31\frac{1}{2}$ Degrees, his meridian Altitude; the Time of Setting will be about Half past 5, and the Twilight about 20 Minutes past 7, in the Evening.

EXAMPLE 2d.

Required the Time of the Sun's Rising and Setting, with the Beginning and Ending of Twilight, on the 14th of November.—I set the Sun to the 14th of *November*, and turn the Horizon as in the last Example; and find the Twilight begins about 45 Minutes past 5, and the Sun rises about 40 Minutes past 7, in the Morning, and sets about 20 Minutes past 4 in the Evening; and the Twilight ends about a Quarter past 6.

PROBLEM III.

To find the Rising, Southing, and Setting of the Stars; with their Right Ascension, Declination, and Meridian Altitude, on any Day of the Year.

Set the Sun's Index to the given Day: Then bring the Eastern Edge of the Horizon to the Star, and it will shew its Amplitude on the Edge of the Horizon; and the Time of its Rising will be shewn by the Index on the Hour Circle. Then bring the Meridian to the Star, and it will shew its meridian Altitude by the Degrees on the Meridian; and the Time of Southing will be shewn

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on the Hour Circle. The Setting is found by bringing the Western Edge to the Star, and the Time of its Setting is shewn on the Hour Circle. For the Declination, bring the graduated Edge of the Moon's Index to the Star, and it will shew the Right Ascension on the Equator; and the Star will shew the Declination on the Moon's Index.

Example.

Required the Rising, Southing, and Setting, of Aldebaran, Sirius, *and* Spica, *on the* 12*th of* April; *with their Declination, Right Ascension, and Meridian Altitude.*—I set the Sun to *April* 12; and, turning the Horizon, find that *Aldebaran* rises about Half past 7 in the Morning, *Sirius* about Half past 12, and *Spica* about Half past 6 in the Evening. *Aldebaran* passes the Meridian about 56 Minutes past 2, and *Sirius* about 12 Minutes past 5, in the Afternoon; and *Spica* about 45 Minutes past 11 at Night. *Sirius* sets about 45 Minutes past 9, and *Aldebaran* about 25 Minutes past 10, at Night; and *Spica* a little past 5 in the Morning. Then, bringing the Moon's Index to the Stars, I find the Right Ascension of *Aldebaran* about 65, of *Sirius* 98, and of *Spica* 198 Degrees: The Declination of *Aldebaran* 16 Degrees North; *Sirius* 16½, and *Spica* 10 Degrees, South: The meridian Altitude of *Aldebaran* about 54, *Sirius* 22½, and *Spica* about 28½, Degrees.

PROBLEM IV.

To set the Moon's Node for any given Day and Year, from 1763 *to* 1910.

Bring the ascending Node to the given Year in the spiral Line, making Proportions for the Months and

Days, by ſetting the Index as many Diviſions and Parts forward toward the next Year as the given Day is Months, *&c.* from the Beginning of the Year.

EXAMPLE.

Required the Place of the Moon's aſcending Node on the 10th of July, 1779. — Having found the Year 1779, in the Spiral within the Month Circle, I count Six of the Subdiviſions toward 1780 for the beginning of *July*, and One Third Part of the next for the Ten Days, and place the Node to that Part, and find it to be in the 9th Degree of Gemini.

PROBLEM V.

To find the Days of all the New and Full Moons and Eclipſes, in any Year, from 1763 *to* 1910, *according to the new Stile.*

Having placed the Node as directed in Problem IV. find the mean Time of New Moon in *January* in the Tables at the Corners; then ſet the Sun to the Day of the Month, (allowing for the Hours;) then move the Moon's Index ſucceſſively to the Strokes at all the New Moons, (on the Hour Circle,) and her Index will ſhew the Days of all the New Moons in the Circle of Months, The ſame for the Full Moons, by bringing her Index to the Strokes at all the Full Moons. Then ſet the Sun and Moon together, and ſet them ſucceſſively to the Days of all the New Moons in the Year, moving the Node forward according to the Months, and the Hole in the Moon's Plate will ſhew the Quantity of all the Eclipſes of the Sun; at the ſame Time the Sun's Index ſhews the Days on which they happen. Then ſet the Moon oppoſite to the Sun, and bring the Sun's

Sun's Index to the Days of all the Full Moons, and the ſame Hole will ſhew all the Eclipſes of the Moon, with the Quantity eclipſed.

Example.

Required the Days of all the New and Full Moons, and Eclipſes, in the Year 1779. — I find in the Table the Time of New Moon in *January* is the 17th Day, at Noon. Having ſet the Sun to the Stroke of the 17th Day, and the Node a little above Half of the Firſt Diviſion from 1779, I bring the Moon's Index to all the New Moons, and find the Days of New Moon to be as follow: The 1ſt on *January* 17 at Noon, the 2d on *February* 15, the 3d on *March* 17, the 4th on *April* 15, the 5th on *May* 15, the 6th on *June* 13, the 7th on *July* 13, the 8th on *Auguſt* 11, the 9th on *September* 10, the 10th on *October* 9, the 11th on *November* 8, the 12th on *December* 7. Then I bring the Moon's Index to all the Full Moons, and find the Days of the Full Moon to be as follow: The 1ſt on *January* 2, the 2d on *January* 31, the 3d on *March* 2, the 4th on *March* 31, the 5th on *April* 30, the 6th on *May* 29, the 7th on *June* 28, the 8th on *July* 28, the 9th on *Auguſt* 26, the 10th on *September* 25, the 11th on *October* 24, the 12th on *November* 23, the 13th on *December* 22. I find alſo there are Six Eclipſes: One of the Sun, on *May* 15; a total one of the Moon, on *May* 29; one of the Sun, on *June* 13; one of the Sun, on *November* 8; a total one of the Moon, on *November* 23; and one of the Sun, on *December* 7.

PROBLEM VI.

To find the Moon's Age on any given Day and Year.

Proceed, as in the laſt Example, to find the Day of New Moon preceding the Day required; then move

the Moon's Index from the Day of New Moon to the given Day; and the Number of Days it passes over is the Moon's Age required.

EXAMPLE.

Required the Moon's Age on the Noon of the 10th of April, 1810, New Stile. — In the Table I find the mean Time of New Moon in *January* to be on the fifth Day at 5 o'Clock in the Afternoon. Having set the Sun to the fifth of *January*, at 5 Hours, I turn the Moon's Index to the New Moon preceding the tenth of *April*, which I find to be on the third of *April* about 18 Hours past Noon; then, moving the Moon's Index forward to the tenth, I find it passes over about six Days and a Quarter, which is the Moon's Age on the Noon of the 10th of *April*.

Note, the Division-Stroke is supposed to be the Noon of the Day according to astronomical Reckoning, and is called the same Day to the Noon of the next. In setting the Sun's Index to any Number of Hours, it must be set in the Proportion they bear to 24 Hours.

PROBLEM VII.

To find the Moon's Latitude, Declination, Place in the Ecliptic, and Right Ascension, at any Time.

Find the Moon's Age, as in the last Example; then set the Sun to the given Day, and move the Moon round till she stands to her Age on the Sun's Plate; then, having set the Node as directed in Problem IV. the Moon's Index will shew her Latitude on the Node Circle, which must be added to the Declination shewn

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on the Declination Circle, if they are of one Denomination, either North or South; but ſubtracted if they are of contrary Denominations: the Sum or Remainder will be the Declination required. The Place in the Ecliptic, and Right Aſcenſion, will be ſhewn the ſame as the Sun's.

Example.

Required the Moon's Latitude, Declination, Place in the Ecliptic, and Right Aſcenſion, on the Noon of the 10*th of* April, 1810, *New Stile.* — Having found the Moon's Age, 6^d 6^h, as in the laſt, and the Place in the Node to be in the 15th Degree of *Libra*, I ſet the Sun to the Day of the Month, *viz.* the 10th of *April*; then, placing the Node in the 15th Degree of *Libra*, and ſetting the Moon to her Age, I find the Moon's Latitude to be five Degrees South, the Declination of the Ecliptic 23 North; which being of contrary Denominations, if we ſubtract the Latitude, 5 Degrees, from the Declination, 23, there will remain 18 for the Declination of the Moon on the 10th of *April* at Noon, her Place in the Ecliptic about 4 Degrees in *Cancer*, and the Right Aſcenſion about 95 Degrees, or 6 Hours 20 Minutes.

PROBLEM VIII.

To find the Time of the Moon's Riſing, Southing, and Setting, with the State of the Tides at any Place on the Tide-Plate, on any given Day.

Having found the Moon's Age, Place, and Declination, as in the laſt Example, bring the Sun's Index to the given Day, and ſet the Moon to her Age; then turn the

the Horizon till the Eastern Edge comes to the Degree of Declination on her Index, and the Time of her Rising will be shewn by the Hour Index; then bring the Meridian to her Index, and it shews the Meridian Altitude, with the Time of her Southing; the Setting is shewn by the Western Edge, as before described; the Tides are shewn by bringing the Places to the high or low Water, and the Times are shewn by the Index on the Hour Circle.

EXAMPLE.

Required the Time of the Moon's Rising, Southing, and Setting, on the 4th of June, 1772, *New Stile, with the Time of high Water at* London *and* Bristol. — I set the Sun to the first New Moon in *January*; and, bringing the Moon's Index to the New Moon preceding the 4th of *June*, I find it to fall a little past the Noon of the 31st of *May*; then, moving the Index to the 4th of *June*, I find it passes over about 3 Days and $\frac{3}{4}$, which is the Moon's Age; then, setting the Sun to the 4th of *June*, and setting the Node to a little more than Five Divisions from 1772 toward 1773, in the spiral Line, I set the Moon to her Age, and find she has above 5 Degrees South Latitude. The Declination of the Ecliptic is 21° and a Half, North; from which I subtract the Latitude, 5 Degrees, which leaves 16 Degrees and a Half for her Declination. Then, bringing the Eastern Edge of the Horizon to 16$\frac{1}{2}$ Degrees on her Index, I find she rises about 40 Minutes past 7 o'Clock in the Morning, passes the Meridian about 3 in the Afternoon, and sets about 20 Minutes past 10 at Night. It is high Water at *London* a little before 6, and at *Bristol* about 20 Minutes past 9, in the Afternoon.

PROBLEM

PROBLEM IX.

To find the Days of the mean Time of all the New and Full Moons, and Eclipses, for any Year in the 18th Century, Old Stile.

This is done by Means of the Tables contained in Pages 15 and 16. Find the mean Time of the New Moon in *January* for the given Year, and the Sun's Distance from the Node, in Table I. and set the Sun to the Day of New Moon, making Proportions for the Hours; then turn the Node till the Number of Signs and Degrees of the Sun's Distance comes to the Sun's Index; then bring the Moon's Index successively to all the New Moons, &c. and the Process is the same as in Problem V. taking Care to move the Node according to the Months, which may easily be done, as some of the spiral Divisions will always answer that Purpose.

Example.

Required the mean Time of the New and Full Moons, and Eclipses, in the Year 1790, *Old Stile.* — In Table I. I find the Time of New Moon in *January* 1790 to be the 4th Day, at 4 Hours past Noon, and the Sun's Distance from the Node is 2 Signs 9 Degrees. Having set the Sun's Index to a little past the Noon of the 4th of *January*, I turn the Node till 2 Signs 9 Degrees come to the Sun's Index, and find the Place of the Node to be in the 4th Degree of *Scorpio*. Then, bringing the Moon's Index successively to the Strokes at all the New and Full Moons, I find the 2d to be on the 2d of *February*, the 3d *March* 4, the 4th *April* 2, the 5th *May* 2, the 6th *May* 31, the 7th *June* 30, the 8th *July* 29, the 9th *August* 28, the 10th

September

September 26, the 11th *October* 26, the 12th *November* 24, the 13th falls on the 24th of *December*. The 1st Full Moon falls on the 19th of *January*, the 2d *February* 17, the 3d *March* 19, the 4th *April* 17, the 5th *May* 16, the 6th *June* 15, the 7th *July* 15, the 8th *August* 13, the 9th *September* 12, the 10th *October* 11, the 11th *November* 10, the 12th *December* 9. The 1st Eclipse, a total one of the Moon, falls on the 17th of *April*; the 2d, of the Sun, *May* 2; the 3d, of the Sun, *September* 26; the 4th, of the Moon, total, *October* 11; the 5th, of the Sun, *October* 26.

TABLE

TABLE I.

Of the Mean Time of the first New Moon in *January*, to the nearest Hour, with the Sun's Distance from the Moon's Ascending Node, from 1700 to 1800, old Stile.

	New Moon.		Dist. fr. Node.			New Moon.		Dist. fr. Node.	
Years.	Days.	Hrs.	Signs.	Deg.	Years.	Days.	Hrs.	Signs.	Deg.
1700	8	15	4	13	1751	15	10	1	16
1	27	12	5	22	2	3	19	1	24
2	16	21	6	0	3	22	16	3	3
3	6	6	6	7	4	12	1	3	11
4	24	3	7	17	5	1	10	3	19
5	13	12	8	25	6	19	7	4	28
6	2	21	8	3	7	8	16	5	6
7	21	19	9	11	8	27	14	6	15
8	10	3	9	20	9	16	23	6	23
9	29	1	10	28	1760	5	7	7	1
1710	18	10	11	6	1	24	5	8	9
1	7	19	11	14	2	13	14	8	17
2	25	16	0	23	3	2	23	8	25
3	15	1	1	1	4	20	20	10	4
4	4	10	1	9	5	10	5	10	12
5	23	7	2	18	6	29	2	10	21
6	11	16	2	26	7	18	11	11	29
7	1	1	3	4	8	6	20	0	7
8	19	22	4	13	9	25	18	1	16
9	9	7	4	21	1770	15	2	1	24
1720	27	5	5	29	1	4	11	2	2
1	16	14	6	7	2	22	9	3	11
2	5	22	6	16	3	11	18	3	19
3	24	20	7	24	4	1	2	3	27
4	13	5	8	2	5	20	0	5	5
5	2	14	8	10	6	8	9	5	13
6	21	11	9	19	7	27	6	6	22
7	10	20	9	27	8	16	15	7	0
8	28	17	11	6	9	6	0	7	8
9	18	2	11	14	1780	23	21	8	17
1730	7	11	11	22	1	13	6	8	25
1	26	9	1	1	2	2	15	9	3
2	14	17	1	9	3	21	13	10	12
3	4	2	1	17	4	9	21	10	20
4	23	0	2	26	5	28	19	11	29
5	12	9	3	3	6	18	4	0	7
6	0	17	3	12	7	7	13	0	15
7	19	15	4	20	8	25	10	1	23
8	9	0	4	28	9	14	19	2	1
9	27	21	6	7	1790	4	4	2	9
1740	16	6	6	15	1	23	1	3	18
1	5	15	6	23	2	11	10	3	26
2	24	12	8	2	3	0	19	4	4
3	13	21	4	10	4	19	17	5	13
4	2	6	8	18	5	9	1	5	21
5	21	4	9	27	6	26	23	7	0
6	10	12	10	5	7	16	8	7	8
7	29	10	11	13	8	5	16	7	16
8	17	19	11	21	9	24	14	8	24
9	7	4	11	29	1800	12	23	9	3
1750	26	1	1	8					

TABLE II.

Of Centurial Differences, for 60 Centuries or 6000 Years, supplemental to TABLE I.

	New Moon.		Sun fr. Node			New Moon.		Sun fr. Node.	
	Days.	Hrs.	Signs.	Deg.		Days.	Hrs.	Signs.	Deg.
100	4	8	4	20	3100	16	11	8	0
200	8	16	9	10	3200	20	19	0	20
300	13	1	1	28	3300	25	3	5	9
400	17	9	6	18	3400	29	11	9	29
500	21	17	11	7	3500	4	7	1	18
600	26	1	3	27	3600	8	15	6	7
700	0	21	7	16	3700	12	23	10	26
800	5	5	0	5	3800	17	7	3	16
900	9	13	4	24	3900	21	15	8	5
1000	13	21	9	14	4000	26	0	0	25
1100	18	5	2	3	4100	0	19	4	14
1200	22	13	6	23	4200	5	3	9	3
1300	26	22	11	12	4300	9	11	1	23
1400	1	17	3	1	4400	13	20	6	12
1500	6	1	7	20	4500	18	4	11	1
1600	10	9	0	10	4600	22	12	3	21
1700	14	18	4	29	4700	26	20	8	10
1800	19	2	9	18	4800	1	16	11	29
1900	23	10	2	8	4900	6	0	4	19
2000	27	18	6	28	5000	10	8	9	8
2100	2	14	10	17	5100	14	16	1	28
2200	6	22	3	6	5200	19	0	6	17
2300	11	6	7	25	5300	23	8	11	6
2400	15	14	0	15	5400	27	17	2	26
2500	19	22	5	4	5500	2	12	7	15
2600	24	7	9	24	5600	6	20	0	4
2700	28	15	2	13	5700	11	4	4	24
2800	3	10	6	2	5800	15	13	9	13
2900	7	18	10	22	5900	19	21	2	2
3000	12	2	3	11	6000	24	5	6	22

PROBLEM

PROBLEM X.

To find the Days of all the New and Full Moons, and Eclipses, in any Year between the Christian Æra and the Beginning of the 18th Century.

Find a Year in the 18th Century, in Table I. of the ſame Number with the Year in the Century propoſed, and take the Time of New Moon and Diſtance from the Node; then from the Table of centurial Differences take as many complete Centuries as, when ſubtracted from the ſaid Year in the 18th Century, ſhall anſwer the given Year; and take the Time of New Moon and Diſtance from the Node for thoſe Centuries from Table II. and ſubtract the ſame from the Time and Diſtance in *January* in the 18th Century, and the Remainder will be the Time of New Moon and Diſtance of the Node required for the given Year.

Note, when the Numbers to be ſubtracted are greater than thoſe they are to be ſubtracted from, 29 Days 13 Hours muſt be added to the Time of New Moon, and 12 Signs to the Diſtance of the Node; the Remainder will be the Time and Diſtance required.

Note alſo, if a Lunation is added to the Time of New Moon, you muſt alſo add the Diſtance of the Node for one Lunation, which is one Sign.

EXAMPLE.

Required the Time of the New and Full Moons, and Eclipſes, for the Year of Chriſt 1002, *which is 7 Centuries before* 1702.—In Tab. I. the Time of New Moon, in *January* 1702, is 21 H. after the Noon of the 16th Day, and the Diſtance of the Node is juſt 6 S. Then, in Table II. I look for 7 Centuries, or 700 Years, and take the Dif-

ference of Time, which is 21 Hours; which, subtracted from 16 Days 21 Hours, the Time of New Moon 1702, leaves 16 Days for the Time of New Moon in *January* 1002. The Distance of the Node for 700 Years is 7 S. 16 Deg. which being greater than the Distance for 1702, I add 12 Signs to that Distance; from which subtracting 7 S. 16 Deg. the Remainder will be 10 S. 14 Deg. for the Distance in 1002. Then, setting the Sun to the Noon of the 16th of *January*, and bringing 10 S. 14 Deg. to the Sun's Index, I find that the ascending Node is in the 2d Degree of Pisces. Then, bringing the Moon's Index over the New Moons, I find the 1st New Moon falls on the 16th Day of *January*, the 2d *February* 14, the 3d *March* 16, the 4th *April* 14, the 5th *May* 14, the 6th *June* 12, the 7th *July* 12, the 8th *August* 10, the 9th *September* 9, the 10th *October* 8, the 11th *November* 7, the 12th *December* 6. The 1st Full Moon falls on the 1st Day, the 2d *January* 30, the 3d *March* 1, the 4th *March* 30, the 5th *April* 29, the 6th *May* 28, the 7th *June* 27, the 8th *July* 26, the 9th *August* 25, the 10th *September* 23, the 11th *October* 23, the 12th *November* 22, the 13th *December* 21. The 1st Eclipse is of the Sun, *February* 14; the 2d, of the Moon, total, *March* 1; the 3d, of the Sun, *March* 16; the 4th, of the Sun, *August* 10; the 5th, of the Moon, *August* 25.

PROBLEM

PROBLEM XI.

To find the Days of all the New and Full Moons, and Eclipses, for any Year before the Christian Æra.

Find a Year in the 18th Century; which, being added to the given Number of Years before *Christ*, made less by one, will make any Number of complete Centuries; then take out the Time of New Moon, and the Sun's Distance from the Node, and work in all Respects as in the last Example.

Example.

Required the Time of the New and Full Moons, and Eclipses, for the 724th Year before the Year of Christ; *namely, the 723d Year before his Birth.* — The Years 723 added to 1777 make them 2500, or 25 Centuries. The Time of New Moon, in *January* 1777, in Table I. is the 27th Day at 6 Hours, and the Sun's Distance from the Node is 6 S. 22 Deg. The Time of New Moon for 2500 Years, in Table II. is the 19th Day 22 H. and the Distance from the Node 5 S. 4 Deg. which, being subtracted from the Time of New Moon and Distance of the Node, in *January* 1777, gives 7 Days 8 Hours for the Time of New Moon, and 1 S. 18 Deg. for the Distance of the Node, in *January*, before *Christ* 724. Then, setting the Sun to the 7th of *January*, and 1 S. 18 Deg. on the Node Circle, to the Sun's Index, and bringing the Moon's Index to all the New and Full Moons, I find them to be as follows: The New Moons; *January* 7, *February* 5, *March* 7, *April* 5, *May* 5, *June* 3, *July* 3, *August* 2 and 31, *September* 30, *October* 29, *November* 28, *December* 27: The Full Moons; *January* 22, *February* 20, *March* 22, *April* 20, *May* 20, *June* 18, *July* 18, *August* 16, *Septem-*

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ber 15, *October* 14, *November* 13, *December* 12. I find also there were 4 Eclipses in that Year, two of the Sun and two of the Moon: The 1st, of the Sun, *May* 5; the 2d, of the Moon, *May* 20; the 3d, of the Sun, *October* 29; the 4th, of the Moon, *November* 13.

PROBLEM XII.

To find the Days of New and Full Moons, and Eclipses, for any Year after the 18th Century, which ends A. D. 1800.

Find a Year in the 18th Century which is a complete Century or Number of Centuries less than the given Year, and take out the Time of New Moon and Distance of the Node; then take out the Time and Distance, for the Number of Centuries, from Table II. and add them to the former, and the Sum will be the Time of New Moon and Distance of the Node, in *January* in the given Year.

Note, If the Sums exceed 29 D. 13 H. in Time, or 12 Signs in the Distance of the Node, those Sums must be subtracted, and the Remainder is the Time required.

Note also, If a Lunation is subtracted from the Time, one Sign must always be subtracted from the Distance, which is the Distance for one Lunation.

Note, In all Problems after the 18th Century the centurial Differences must be added, and in all before they must be subtracted.

EXAMPLE.

Required the Times of the Eclipses for the Year 3540, *Old Stile.* — Having found the Times of the New and Full Moons in the Manner directed, I find there will be 5 Eclipses,

clipses, as follows: One of the Moon, on the 20th of *March*; one of the Sun, on the 4th of *April*; one of the Sun, on the 30th of *August*; one of the Moon, on the 14th of *September*; and a small one of the Sun, on the 28th of *September*.

These are a few of the Problems which may be performed by this Rotula; which, in fact, are but a Few more than may be performed by it at one Setting.

Note, In all Leap-Years, which in the Rotula are marked with Dots, a Day must be added to the Time of New Moon in *January* and *February*; the other Years and Months are right.

In all Problems done by this Rotula according to the old Stile, the Difference of Days must be added to the Time of New and Full Moon shewn by the Rotula: Thus, the Days to be added, from 1700 to 1800, are 11; from 1800 to 1900, 12; from 1900 to 2100, 13; *&c.*

The Way to find how many Days to add for any Century, is to divide the Number of the Century by 4, (not regarding the Remainder,) and add 3 to the Quotient; which Sum subtracted from the Number of the Century, the Remainder is the Number of Days to be added.

Thus: The Year 2700 divided by 4, the Quotient is 6, which, by adding 3, makes 9; which, subtracted from 27, the Number of the Century, leaves 18, the Number of Days to be added for the 27th Century.

THE END.

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These are a few of the Problems which may be performed by this Rotula; which, in fact, are but a few more than may be performed by it at one Setting.

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The Way to find how many Days to add for any Century, is to divide the Number of the Century by 4, (not regarding the Remainder) and add 3 to the Quotient; which Sum subtracted from the Number of the Century, the Remainder is the Number of Days to be added.

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T H E E N D.